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Ethnobotany of Rue (*Ruta graveolens* L.): an overview

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Abstract. Uses and properties attributed to *Ruta graveolens* L., an ancient medicinal plant, suggest a modern scientific approach that allows to fully evaluate the applicative potentiality of allelochemicals of this species both in medical and ecological fields.

Riassunto. Gli usi e le proprietà attribuite a *Ruta graveolens* L., un'antica pianta medicinale, suggeriscono un approccio scientifico moderno, che consenta di valutare appieno le potenzialità applicative degli allelochimici di questa pianta, sia in campo medico che ecologico.

Key words: Ethnobotany, Natural pesticides, Pharmacognosy, *Ruta graveolens*

The medicinal plants mentioned in ancient texts deserve modern scientific investigation. Indeed, we are lulled into neglecting an important source of information: history.

HISTORY OF THE PLANT

Rue (*Ruta graveolens*, Rutaceae) is an evergreen plant native of Southern Europe with bluish-green leaves that emit a powerful odour and have a bitter taste. The plant is cited in the ancient herbals and has deep roots in folklore, alchemy and even demonology. Rue has been regarded from the earliest time as successful in warding off contagion and preventing the attacks of fleas and other noxious insects. The name rue derives from the Greek "reuo" (= to set free), because the plant is efficacious in

various diseases. Rue was the chief ingredient of the famous antidote to poison used by Mithridates (GRIEVE, 1967). It was also known to produce erythema and pustular eruptions on human skin (BENEZRA et al., 1985). Many remedies containing rue as well as its abortive properties were mentioned by Pliny the Elder (23-79 AD) in his *Naturalis Historia* (XX, 143) (RACKAM et al., 1938-1962). In Europe, rue was considered a powerful defence against witches during the Middle Ages. Piperno, a Neapolitan physician, in 1625, recommended rue as a treatment for epilepsy and vertigo. Today, the aerial parts of the plant are eaten in Italian salads, and are said to preserve the eyesight (GRIEVE, 1967). Rue is currently mentioned in the pharmacopoeias of 28 countries where it is considered mainly as a stimulating, antispasmodic, diuretic and emmenagogue (PENSO, 1983). Moreover, fresh and dried leaves are used to preserve and flavour beverages and foods such as liquor (grappa) and wine, cheese and meat (DUKE, 1985).

BOTANY AND PHARMACOGNOSY OF RUE

Rue is a perennial herb, glabrous, glandular, punctate, and more or less woody at the base. The stem is 14 to 15 cm high. Leaves are alternate, 2 to 3 pinnatisect, the lower ones with varying length petiols and the upper ones subsessile. Inflorescences are cymose, rather lax. Flowers are yellow; sepals 4, lanceolate, acute; petals 4, denticulate, revolute at the apex, like a spoon; terminal flowers of the cymes with 5 sepals and 5 petals. Fruit is a glabrous capsule, 4-lobed, dehiscent, with a pedicel longer than the capsule (Fig.1) containing hard black seeds (Fig. 2).

Rue flowers are protandrous; in fact, anthers at the onset of anthesis bend back and half concealed in the spoon like petals. There are usually two, but sometimes one or three anthers per petal. When the first stamens bend upwards, the style is short. The style grows and becomes receptive some time before the last stamen has risen. At the base of the ovary there are eight large eye like nectaries which produce great quantities of nectar.

Fig. 1 - Rue drug. First line: dried pieces of leaves with inferior page dotted with glands. Second line: dried pieces of leaves. Third line: foliar stem sections. Bottom: pieces of flowers and capsules (fruits) dotted with glands. (2x) (After HÖRHAMMER, 1955).

After the stigma develops, stamens bend up again, and autogamy is inevitable. During this phase the nectaries are dry.

DELPINO (1868), to whom we owe many modern terms and concepts of pollination ecology, pointed out the role of dichogamy in flowering plants.

Secondary chemical constituents and potential allelochemicals of rue are listed in Tab. 1. The term allelochemical coined by WHITTAKER & FEENY (1971) recognised that many naturally produced substances usually called secondary metabolites have the ability to affect the growth, health, population biology or behaviour of another species.

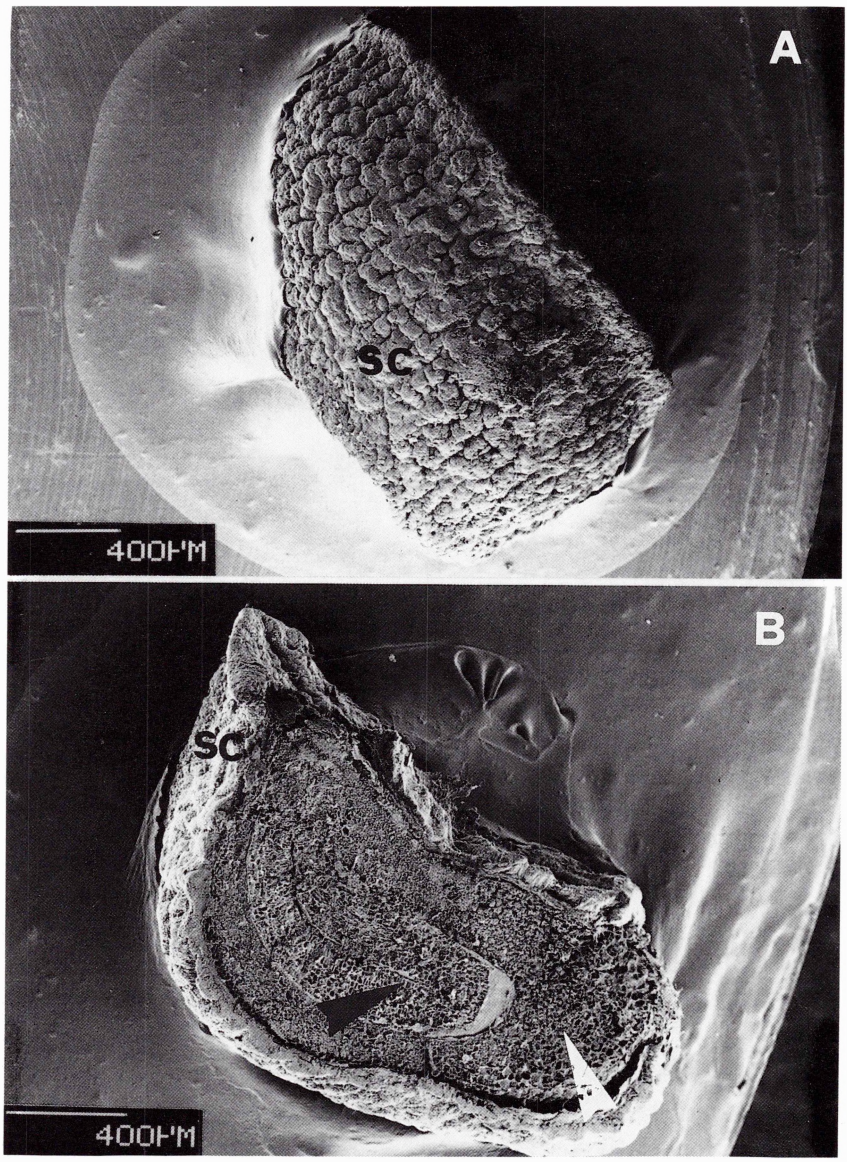

Fig. 2 - Scanning electron microscopy micrographs of *Ruta graveolens* seed. (**A**) A view of the seed coat (sc). (**B**) Longitudinal section of the seed showing the seed coat (sc), endosperm (white arrow), and the embryo (black arrow). (G. Cafiero, unpublished).

Tab. 1 - Secondary chemical constituents of *Ruta graveolens* (After MURRAY et al., 1982, modified).

Compound	Plant part examined
Alkaloids	
Arborinine	
g-Fagarine	
Graveoline	
Graveolinine	
Kokusaginine	
6-Methoxy-dictamine	
Rutacridone	
Skimmianine	
Coumarins	
Bergapten*	Stems, leaves, cell cultures
(-)-Byakangelicin	Roots
Chalepensin	Roots
Coumarin*	Leaves
Daphnoretin	Aerial parts
Daphnoretin methyl ether	
Daphnorin	Roots
Gravelliferone	Roots
Gravelliferone methyl ether	Roots
Herniarin	Cell cultures
Isoimperatorin	Roots and stems
Isopimpinellin	Cell cultures
Isorutarin	Cell cultures, roots
Marmesin	Cell cultures, roots
Marmesinin	Roots
8-Methoxy-gravelliferone	
Pangeline	
Psoralen*	Cell cultures, roots, stems, leaves
Rutacultin	Roots
Rutamarin	Aerial parts, roots, stems
Rutamarin alcohol	Roots
Rutaretin	Leaves (?)
Rutarin	Aerial parts, roots
Scopoletin	Cell cultures
Suberenon	Roots
Umbelliferone*	Cell cultures, roots
Xanthotoxin*	Cell cultures, stems, leaves
Xanthyletin	Roots

Tab. 1 - (Continued).

Compound	Plant part examined
Flavonoids	
Quercetin*	Leaves
Rutin*	Leaves
Ketones	
Methyl-nonyl-ketone	Aerial parts
Methyl-heptyl-ketone	Aerial parts
Organic acids	
Anisic acid	
Caprinic acid	
Caprylic acid	
Oenanthylic acid	
Plagonic acid	
Salicylic acid*	
Terpenoids	
Cineole*	Aerial parts
Limonene*	Aerial parts
Pinene*	Aerial parts
Guaiacol	Aerial parts

*Allelochemicals are marked with an asterisk.

RUE AND SUSTAINABLE AGRICULTURAL SYSTEMS

Plants interact with the other organisms through the release of allelochemicals into the environment (allelopathy). An increased knowledge of allelopathy can aid in the development of sustainable agricultural systems, enabling farmers to use the natural herbicides against pests (RICE, 1984). The use of natural plant products in comparison to synthetic chemicals is considered safer for enviroment because of their biodegradability.

The presence of large amounts of coumarins on the leaf surface of rue and their easy extraction through leaching (ZOBEL & BROWN, 1988) suggested us to test the allelopathic properties of rue infusion and its allelochemicals in pest management. Three

active pure compounds (5-methoxypsoralen, 8-methoxypsoralen, and 4-hydroxycoumarin) inhibiting radish germination were isolated from rue extract (ALIOTTA et al., 1994).

Weed control

On the basis of results obtained in radish seeds, we began to use the rue extract as a possible bioerbicide against germination of weeds in an agricultural soil. Greenhouse experiments were done in pots containing field soil and applied (10% w/v) doses of aqueous leaf extracts of rue. Weed emergence was delayed in treated pots compared to control when concentrations of rue extracts at 10% were applied to the soil 2 and 3 times at intervals of five days. Purslane (*Portulaca oleracea* L.) and purple nutsedge (*Cyperus rotundus* L.) constituted 95% and less than 5% of total weeds population, respectively; a small number of redroot pigweed (*Amaranthus retroflexus* L.), lambquarter goosefoot (*Chenopodium album* L.), bermuda grass (*Cynodon dactylon* L.) and dwarf spurge (*Euphorbia exigua* L.) were also recorded. Finally, rue extract stimulates soil respiration and increases soil microbial biomass (ALIOTTA et al., 1993-1994; 1995).

Insect control

Rue is traditionally used against insects. Although some of its allelochemicals are involved in plant-insects interactions, the plant has not received much attention in terms of its potential in the insect pest control. We have tested the effectiveness of aqueous rue extract against the growth and development of the Mediterranean fruit fly (medfly, *Ceratitis capitata* Wiedmann) and the mosquito larvae (*Culex pipiens* L.) (G. Aliotta, unpublished). The medflies have migrated around the world and have caused serious damages in many crops, fruits and vegetables. Rue extract (10%) added to the artificial diet of medfly (a) determined 100% mortality of medfly eggs, (b) delayed the metamorphosis of first instar larvae for two days and produced less pupae (64%) than control (83%), and (c) caused failure to produce adults in most of the pupae from treated first instar larvae. Rue extract showed marked inhibitory effects on mosquito larvae.

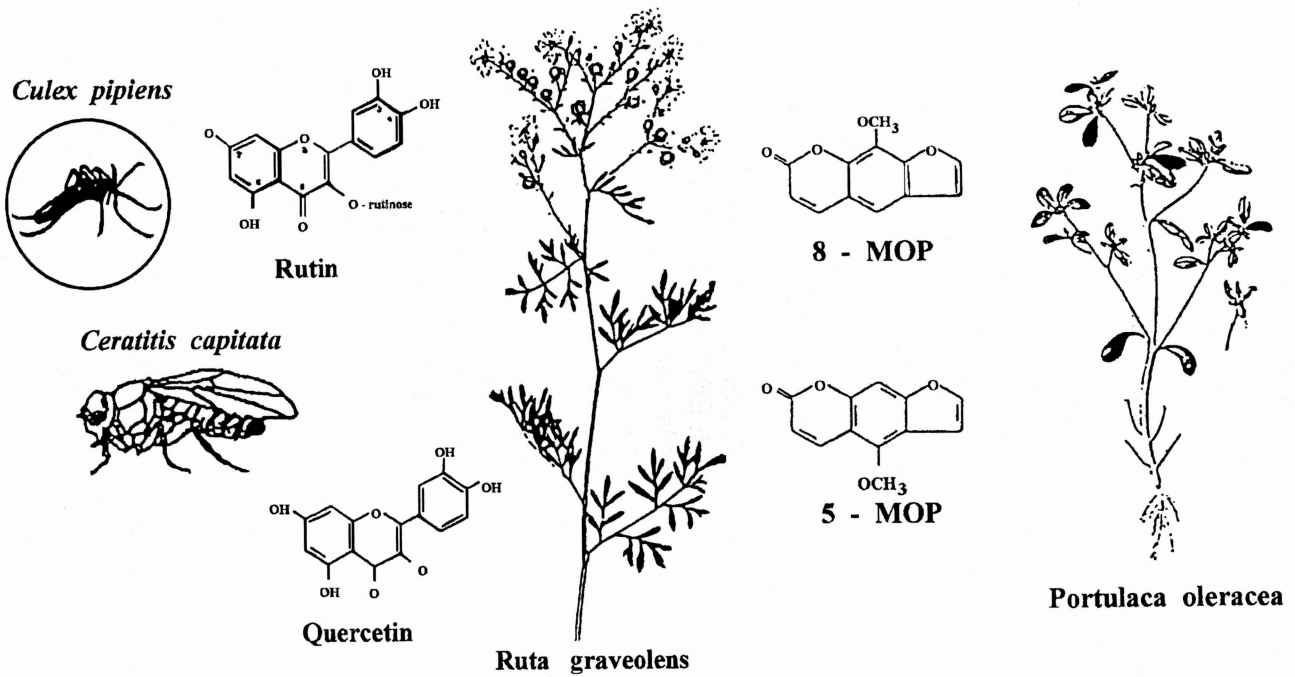

Fig. 3 - Allelopathic interaction of *Ruta graveolens* L.

Indeed, rue leachates at 1% and 2% induced 50% and 100% mortality of larvae, respectively. Preliminary studies carried out with the aim to isolate and to identify the active constituents of rue extract indicate that some flavonoids and coumarins are responsible for the biological activity (G. Aliotta, unpublished) (Fig. 3).

Such findings open up a promising avenue in the search of natural pesticides. To ascertain the potential of the simple rue infusion as a cheep tool for pest management in crops (e.g., its biodegradability and selectivity) more research is needed. It is advised to assay the allelopathic effects of medicinal plants for their active principles and it is time to consider the role of allelopathy in the development of sustainable agricultural systems.

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